

UNDERSTANDING THE LINKS BETWEEN AGRICULTURE AND HEALTH

Agroforestry, Nutrition, and Health

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Agroforestry is an ancient land use practice and modern science involving the deliberate management of trees on farms and in surrounding landscapes. Agroforestry systems vary greatly in tree species mix, complexity, configuration, and input requirements, producing a wide range of products and services. With appropriate technical and institutional support, the practice of agroforestry can contribute to rural food and health systems and help buffer households against health and nutrition shocks. As a science, agroforestry integrates perspectives from agriculture, ecology, and rural development.

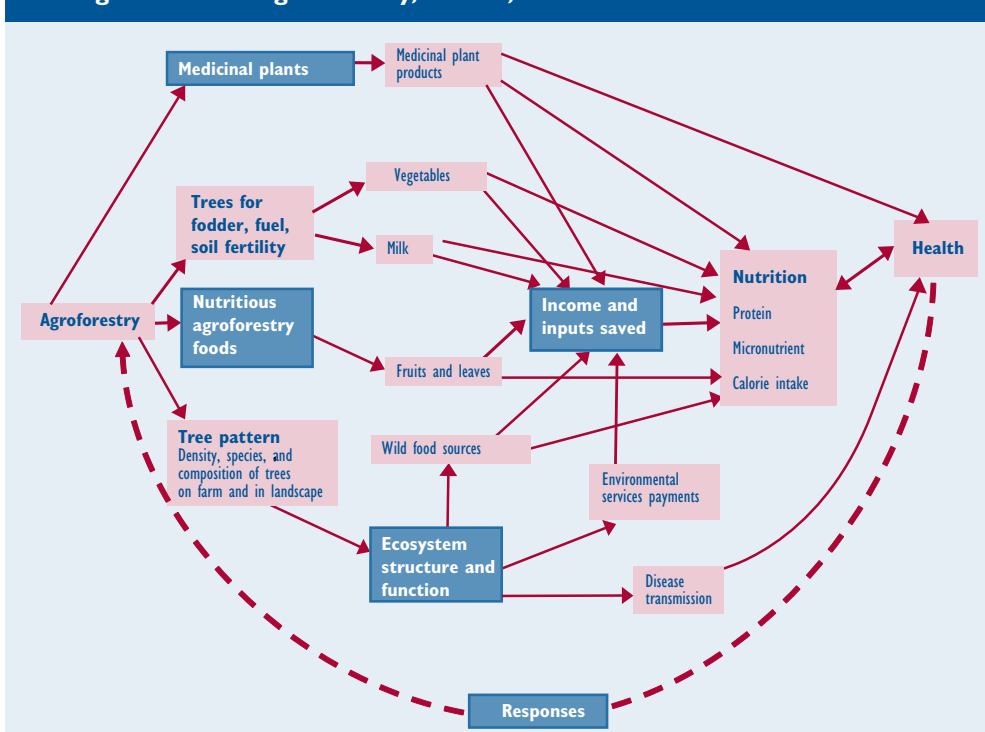
For the practice of agroforestry to yield its full potential, it needs to bring health and nutrition to the fore. The figure presents a simple conceptual framework of agroforestry, health, and nutrition linkages that focuses on five pathways between agroforestry and health, dubbed the MINER pathways: M—medicinal plant conservation, domestication, and propagation; I—income earned and inputs saved through improvements in the farm resource base and products for sale; N—nutritious agroforestry foods, including fruits and leaves; E—changes in ecosystem structure and function that affect disease risk and transmission; and R—responses of agroforestry priorities and program design to changes in farmers' circumstances resulting from health and nutrition problems. The rest of this brief briefly discusses the five MINER pathways.

MEDICINAL PLANT PATHWAY

Across much of Africa and Asia, people use traditional medicines—based largely on products from trees, shrubs, and herbs—to help meet

their primary health care needs. The World Health Organization (WHO) estimates that about two-thirds of the world's population, and 80 percent of Africa's population, sometimes use herbal or traditional medicines. WHO also estimates that the global market for herbal medicines is worth more than US\$60 billion per year. Despite its huge monetary value, the herbal medicine industry still relies largely on plant products collected from the wild. Those wild areas are decreasing in area, and remaining wild areas are often overharvested. A case in point is *Prunus africana* (variously called bitter almond, iron wood, or red stinkwood in English), a slow-growing African hardwood tree.¹ Bark from *Prunus africana* trees is used in a treatment for prostrate disorders, especially in Europe and North America. While it is technically possible to harvest bark from *Prunus africana* sustainably, bark poachers tend to either cut down mature trees or strip live trees entirely of their bark, killing the tree. As a result, the tree is now in Appendix II of the Convention on the International Trade in Endangered Species (CITES). One potential solution is to incorporate *Prunus africana* into agroforestry systems (an approach currently being studied by the World Agroforestry Center): vegetative propagation methods have been found effective in propagating high-quality trees growing in the wild and making that material available to smallholder farmers. This approach is also being extended to two tree species whose products are used to treat malaria, *Artemisia annua* (sweet wormwood), indigenous to China, and *Warburgia ugandensis* (East African greenwood, East African greenheart, or pepper-bark tree), indigenous to Africa.

Linkages between Agroforestry, Health, and Nutrition



INPUT AND INCOME PATHWAY

Agroforestry systems offer farmers opportunities to diversify their income and to increase farm production, allowing them to increase the resources they devote to purchasing food and countering disease. Agroforestry can improve soil fertility, provide animal fodder, produce tree fruits, expand fuel wood supplies, and produce a variety of wood products for farmers' home use and sale. Research results from around the developing world show that financial returns generated from agroforestry systems vary greatly but are generally much higher than returns from continuous unfertilized food crops (see table). The higher returns associated with agroforestry can translate into improved household nutrition and health, particularly when the income is controlled by women. Unfortunately, however, there is scant empirical evidence that agroforestry income produces these health benefits. Monitoring and impact assessment studies need to give more attention to how agroforestry affects household resource allocation, consumption patterns, nutrition status of household members, and health.

¹ Botanic names and English names of trees are taken from the World Agroforestry Centre agroforestry database, located on the Internet at <http://www.worldagroforestry.org/Sites/TreeDBS/Treedatabases.asp>.

Income Benefits of Agroforestry Systems

COUNTRY	AGROFORESTRY SYSTEM	DISCOUNTED PRESENT VALUE IN US\$/HECTARE	COMPARISON WITH RETURNS FROM NONAGROFORESTRY LAND USE
Tanzania	Rotational woodlots	US\$500 over 5 years	Agroforestry return is 6.3 times higher than unfertilized maize
Uganda (southwest)	Tree fallows on scoured terrace benches	US\$155-917 over 4 years	Net loss of US\$4 over 4 years from continuous maize
Nepal	Rotational woodlots	Mean annual return of US\$1,582 or US\$2,796 for 2 agroforestry systems	Mean annual return of US\$804 for continuous maize
Viet Nam	<i>Tephrosia candida</i> as fallow, hedgerow, or mulch on upland rice	Net loss of US\$59 to net gain of US\$123 over 4 years	Net loss of US\$33 over 4 years for continuous monocrop upland rice
India	Biodiesel using <i>Jatropha curcas</i>	US\$853 over 30 years	Wastelands assumed to have 0 opportunity costs

NUTRITIOUS FOOD PATHWAY

Agroforestry has the potential to contribute to human nutrition through increased production and availability of particularly nutritious fruits and leaves and through general diversification of farmers' diets. Agroforestry research and development organizations in Africa are promoting a number of tree products with particularly nutritious fruits and leaves, including indigenous trees such as *Adonsonia digitata* (baobab) and *Uapaca kirkiana* (wild loquat) and exotic trees such as *Moringa oleifera* (drumstick tree) and *Psidium guajava* (guava). The nutritional profile of some of these products is impressive. For example, the leaves and fruits of the baobab tree contain beta-carotenes and vitamin C, while the leaves of *Moringa oleifera* are rich in vitamin C and beta-carotene and contain significant amounts of protein, phosphorus, lipids, and calcium. A study in Zimbabwe by the World Agroforestry Centre and Hanover University showed that many households consumed large amounts of fruit and generated considerable income from indigenous fruits. Within households, children were the main consumers of fruit. Research and development are therefore now focused on on-farm production of indigenous trees, production of new products from indigenous fruits, and expanded production of selected exotic species.

ECOSYSTEM SYSTEM STRUCTURE AND FUNCTION PATHWAY

It is now recognized that one of the critically important services that ecosystems play is controlling the emergence and spread of infectious and vector-borne diseases by maintaining equilibria among predators and prey, and among hosts, vectors, and parasites in plants, animals, and humans. As a land use that is intermediate between undisturbed forests and annual cropping, agroforestry has the potential to have positive and negative impacts on disease risks. Depending upon whether agroforestry systems replace annual crops or primary forests, agroforestry can change (1) the risk of malaria (by changing ambient temperatures and pools of standing water); (2) the risk of African animal and human trypanosomiasis (by changing the habitat for tsetse flies and animals that provide blood meals for tsetse); and (3) the quality of water in natural ecosystems. Agroforestry products can also be used for environmental benefits. The seeds of *Moringa oleifera* (drumstick tree), for example, have the potential to clarify and reduce bacteria loads in drinking water, and *Dendrocalamus giganteus* (giant

bamboo) can absorb large quantities of nutrients from human or animal waste. The particular relationships between agroforestry, alternative land uses, and health tend to be context specific, so more studies across a range of contexts are needed.

FEEDBACK EFFECTS FROM HEALTH TO AGROFORESTRY

Just as agroforestry has the potential to improve health, the health status of communities also affects agroforestry. Health and nutrition status affect how people use trees and other natural resources, the amounts and types of resources they apply to their farming operations, and how they perceive the attractiveness of various agroforestry systems. Households suffering the effects of chronic

illness or death tend to increase their reliance on woodland resources for food and income. Such households are likely to reduce their use of purchased inputs for farming and to become discouraged from adopting agroforestry systems owing to their delayed payoffs and high management demands. HIV/AIDS is one disease with particularly large impacts on these feedbacks (see also Brief 7). Yet agroforestry systems can also respond to the HIV/AIDS epidemic through the first four pathways, as follows:

- Agroforestry systems can produce medicinal products to help treat symptoms and opportunistic infections. For example, the African tree *Melaleuca alternifolia* (tea tree) contains an anti-fungal substance that combats *Candida albicans*, the bacteria responsible for fungal skin problems and mycosis (a condition that commonly affects the eyes of AIDS patients).
- They can produce nutritious foodstuffs (fruits and berries).
- They can generate income through woodlots and improved fallow methods that require relatively low intensities of labor and purchased inputs.
- They can mark ownership of land for widows and orphans.

CONCLUSIONS

This brief suggests the large potential, but also the complexity, of the possible links between agroforestry, health, and nutrition. Across the developing world, farmers and other rural residents use products from hundreds of tree species, often in many different ways, to meet their subsistence food needs, diversify their diets, generate income, and treat a wide range of ailments. At the landscape level, agroforestry contributes to the complexity of vegetation profiles and landscape mosaics, in the process changing the epidemiology of infectious and vector-borne diseases. It is not surprising, therefore, that there is relatively little conclusive evidence of direct links between agroforestry and health. Nonetheless, there is an urgent need to generate and synthesize such evidence. Health and nutrition interventions will be made more effective when they are able to incorporate tree components in full confidence of the likely impacts. ■

For further reading see B. Swallow, P. Thangata, S. Rao, and F. Kwesiga, eds., "Agroforestry Responses to HIV/AIDS in East and Southern Africa," Occasional Paper No. 1 (Nairobi: World Agroforestry Centre, 2005).

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